Intervertebral joint prosthesis for the cervical spine

Joint prostheses for replacement of an intervertebral disk of the cervical spine are known which are composed of two cover plates and a hinge core. The cover plates, arranged approximately parallel to one another on both sides of the core, have surfaces intended for connection to the end plates of the adjacent vertebral bodies. Known prostheses of this type (FR-A-2718635, EP-B-699426, WO 03063727, WO 0211650, EP-A-1166725, EP-A-820740) are circularly delimited. Since the end plates of the vertebral bodies are considerably wider than deep in the AP direction, these known prostheses do not exploit the extent of the naturally available surfaces for force transmission. As a consequence of this, greater forces arise between the prosthesis surfaces and the vertebral bodies than would be the case if the surfaces were better utilized. In intervertebral disk prostheses intended for the lumbar spine, the best utilization of space is achieved by using an oval prosthesis contour (WO 0101893, EP-B-471821, EP-A-747025) or kidney-shaped configuration (US-A-6296664, EP-A-747025). Rectangular prosthesis shapes are also known (US-A-5425773, DE-A-4423826).

Inventions for which applications have previously been filed by the same Applicant or its legal predecessors (EP-A-1344508, EP-A-1344507, WO 03075803, WO 03075804) disclose a prosthesis contour shape which is approximate to a rectangle with rounded corners and covers the substantially flat area of the end plates of the vertebral bodies. They achieve a much better utilization of space and more reliable long-term connection to the vertebral bodies than do circularly delimited prostheses. In addition, they have a low height and therefore require only a small amount of natural bone substance to be removed for preparing the implantation space. In many cases, they permit complete or partial preservation of the hard but, in the case of the cervical vertebrae, very thin cortical bone.

It is known that good adaptation of the shape of the prosthesis surface to the shape of the vertebral body surface promotes lasting adherence of the prosthesis to the bone. From this it was concluded that the surface of a prosthesis provided as a serial product for many applications should match as exactly as possible the

average surface shape of the vertebral bodies (US-A-5514180, DE-A-4423826). In most cases, a gently convex shape of the prosthesis surface was chosen (WO 9720526, US-AS-6083228, US-A-6517580)

Unlike cervical joint prostheses, cages are used for immovably fixed connection of adjacent vertebral bodies for the purposes of their fusion. Since they are intended for union of the vertebrae, less importance is placed on the quality of their actual long-term connection to the bone. The preservation of the natural bone substance is also less important since it is replaced by homologous material stored in the cage (EP-B-179695, WO 9720526, US 2001/0016774, WO 0191686, WO 9000037).

The invention aims to develop the prosthesis type (WO 03075804) disclosed in the aforementioned earlier applications, with the objective of improved force transmission between the prosthesis and the end plates of the vertebral bodies, while at the same time substantially preserving the natural bone substance.

The invention is based on the knowledge that the end plates of the vertebral bodies of the cervical spine have a different degree of mineralization in different regions. The greater the mineralization, the more compact the bone substance and the more suitable it is to take up forces. It has been found that the highest degree of mineralization is present in lateral edge zones of the end plates of the vertebral bodies where the substantially flat central area of these end plates, in frontal section, merges into a stronger curvature that leads to the uncovertebral joints. The underlying concept of the invention lies in using these edge zones for transmission of forces between the prosthesis and the bone. The prosthesis surfaces intended to bear on the vertebral body surface are extended laterally into the more strongly mineralized and at least partially more strongly curved lateral edge zones of the vertebral body surface. So that the greater strength of these edge zones of the end plates of the vertebral bodies can be utilized, they must be preserved even if the prosthesis height or the adaptation of the bone to the prosthesis shape demands a certain degree of milling of the end plates of the vertebral bodies. This milling is limited substantially to the central area of the end plates of the vertebral bodies where the bone strength is lesser anyway, whereas the stronger edge zones are completely or partially preserved. The prosthesis shape according to the invention permits this by virtue of the extent of its convex

curvature. It departs from the previous view that the prosthesis surface should correspond as far as possible to the natural shape of the vertebral bodies. Instead of this, the convex curvature of the prosthesis surface is chosen to be greater than the curvature of the associated end plate surface. That is to say the central areas of the prosthesis surface protrude farther upward or downward than the edge zones in relation to the surface of the vertebral bodies. This state of affairs is expressed in the claims in terms of the distances at which the different areas of the end plates and of the prosthesis surface are situated from a midplane of the intervertebral space. In frontal section, an end plate surface has, in its central and less mineralized area, a first distance from the midplane, and, in its lateral and more strongly mineralized lateral edge zones, a second distance from said midplane. In the same frontal section, in its central surface area intended to bear on the central area of the end plate surface, the prosthesis is at a third distance from the same midplane, and, in its edge zones intended to bear on the lateral edge zones of the end plate surface, it is at a fourth distance from the same midplane. The third distance is greater than the fourth, and the difference between the third and fourth distances is greater than the difference between the first and second distances. The height of the prosthesis is limited in the edge zones such that milling

Claims

1. An intervertebral joint prosthesis for an intervertebral space of the cervical spine, which intervertebral space is delimited by the end plates (12, 13) of the adjacent vertebral bodies whose surfaces, in a frontal plane, laterally adjacent to a substantially flat central area (2), have more strongly curved edge zones (4), an end plate surface (27) having, in frontal section, in its central and less mineralized area (2), a first distance (18) from a midplane (20), and, in its lateral and more strongly mineralized lateral edge zones (4), a second distance (19) from said midplane (20) of the intervertebral space, the prosthesis, in the same frontal section, in its central surface area (8) intended to bear on the central area (2) of the end plate surface (27), being at a third distance (21) from the same midplane (20'), and, in its edge zones (10) intended to bear on the lateral edge zones (4) of the end plate surface (27), being at a fourth distance (22) from the same midplane (20'), and the third distance (21) being greater than the fourth (22), and the difference (23) between the third and fourth distances (21, 22) being greater than the difference (24) between the first and second distances (18, 19).

2. The prosthesis as claimed in claim 1, characterized in that its height in the caudo-cranial direction in the lateral edge zones (10, 14, 17) is approximately equal to the height of the intervertebral space at this location, and its height in the central area (8) is greater than that of the intervertebral space at this location.

3. The prosthesis as claimed in claim 1 or 2, characterized in that the prosthesis surface is provided with elevations and depressions in the central area (8), but not in the edge area.

4. The prosthesis as claimed in one of claims 1 through 3, characterized in that the prosthesis surface is toothed in the central area (8).

5. The prosthesis as claimed in claim 1 or 2, characterized in that the angle of inclination (α) of the edge zones (10) of the lower prosthesis surface (9) in the

frontal plane relative to the main direction of extent (14) of the prosthesis reaches at least 20°.

6. The prosthesis as claimed in one of claims 1 through 5, characterized in that the angle of inclination (β) of the edge zones (10) of the upper prosthesis surface (11) relative to the main direction of extent (14) of the prosthesis reaches at least 0° and preferably 10 to 30°.

7. The prosthesis as claimed in one of claims 1 through 6, characterized in that the width (15) of the prosthesis is at least 1.5 times as great as the depth (16) by which it is intended to lie in the intervertebral space.

8. The prosthesis as claimed in one of claims 1 through 6, characterized in that the specified shape of the prosthesis is limited to its dorsal half.

9. The intervertebral joint prosthesis, in particular as claimed in one of claims 1 through 8, characterized in that the surface of at least one of its cover plates, whose size is dimensioned to substantially utilize the naturally provided surface extent of the intervertebral space, has a central area (8, 50), which extends approximately parallel to the main plane of extent of the cover plate, and, adjoining this in the dorsolateral direction, a surface (10, 51) beveled relative to the central area.

10. An instrument set for inserting the prosthesis as claimed in one of claims 1 through 9, with at least one rasp (54) which reflects the configuration of the prosthesis and which adapts the vertebral body surfaces to the prosthesis shape, which is designed such that it includes the central area and the edge zones and substantially spares at least the dorsal part of the edge zones from removal of material.